

Field Report for Airborne Data Collected In Support of US EPA Region VI Clean Solvents Recycling Fire 6 April 2018

Background

On 6 April 2018 a large fire developed at the Clean Solvents recycling facility located near Mansfield, TX. Local news outlets report that the blaze started at about 0100 (local) 6 April 2018 and was reported to have generated explosions due to paint and solvent containers rupturing due to the fire. Heavy smoke was also reported. On-site perimeter air monitoring conducted by fire personnel did not show detectable quantities of volatiles compounds. The fire personnel indicated that onsite teams planned to let the fire burn out since the blaze was not threatening homes in the area.

The US EPA Region VI requested that the ASPECT system be deployed to provide monitoring support at approximately 0605 on 6 April 2018. ASPECT was formally notified to launch at 0650 and was airborne at 0755. Since the fire was within the metro-plex area, flight time to the target was about 25 minutes.

The Clean Solvents recycling facility is located 6.5 kilometers northwest of Mansfield, TX. The geographical coordinates of the facility are 32.6042N, 97.1896W (figure 1). The area is located in semi-rural area with isolated housing developments within 1 km of the site.

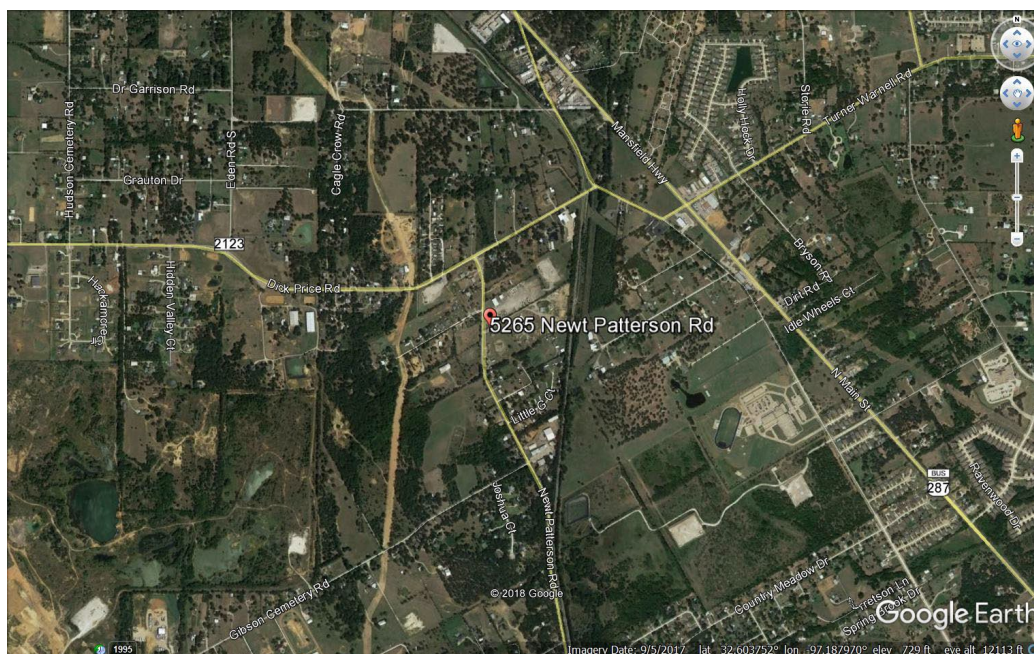


Figure 1: Clean Solvents Recycling, Mansfield, TX

ASPECT response to this Mission/Incident was in support of:
US EPA Region 6. OSC: Pratisha Adams and Bryant Smalley

ASPECT System

The US EPA ASPECT system collects airborne infrared (IR) images and chemical screening data from a safe distance over the site (about 3,000 ft AGL). The system consists of an airborne high speed Fourier transform infrared spectrometer (FTIR) coupled with a wide-area IR line scanner (IRLS). The ASPECT IR systems have the ability to detect compounds in both the 8 to 12 micron (800 to 1200 cm⁻¹) and 3 to 5 micron (2000 to 3200 cm⁻¹) regions. The 8 to 12 micron region is typically known as the atmospheric window region since the band is reasonably void of water and carbon dioxide influence. Spectrally, this region is used to detect carbon - non-carbon bonded compounds. The 3 to 5 micron region is also free of water and carbon dioxide but typically does not have sufficient energy for use. This band does show use in high-energy environments such as fires. The carbon - hydrogen stretch is very common in this region.

A digital Nikon DX2 camera (12.4 mega pixel CMOS 3:5 aspect ratio, 28 mm wide-angle lens) collects visible aerial imagery as part of the core data product package. The camera timing system is connected to the primary IR sensors and provides concurrent image collection when other sensors are triggered. All imagery is geo-rectified using both aircraft attitude correction (pitch, yaw, and roll) and GPS positional information. Imagery can be processed while in flight or approximately 600 frames per hour can be processed once the data are downloaded from the aircraft.

An Imperx mapping camera (29 mega pixels; mapping focal plane array) provides a similar aspect ratio and aerial coverage. Like the Nikon DX2, it is connected to the primary IR sensors and provides concurrent image collection when other sensors are triggered. These images are often digitally processed in lower resolution so they can be transmitted via satellite communication. The high resolution images (>20 MB each) are pulled from the ASPECT after the sortie and are available at a later time.

All aerial photographic images collected by the ASPECT system are ortho-rectified and geospatially validated by the reachback team. In general, this consists of conducting geo-registration using a Digital Elevation Model (DEM) which promotes superior pixel computation and lessens topographic distortion. The image is then check by a team member (using a Google Earth base map) for proper location and rotation

Data is processed using automated algorithms onboard the aircraft with preliminary results being sent using a satellite system to the ASPECT reachback team for QA/QC

analysis. Upon landing preliminary data results are examined and validated by the reachback team.

Weather Conditions and Crew Report

Weather for the mission is given in table 1.

Table 1. Clean Solvent Mission Weather

Parameter	surface (0800)	0900
Wind direction	160 degrees	210 degrees
Wind speed	4.5 m/s (9 kts)	2.6 m/s (5 kts)
Temperature	20.6°C	21°C
Humidity	93%	92%
Dew Point	19°C	19.4°C
Pressure	1007 mb	1007 mb
Ceiling	213 m (700 ft)	213 (700 ft)

The crew reported that winds at altitude (700 ft) were from 150 degrees at 2 m/s (4 kts). Very little smoke (blue to gray in color) was observed with a faint smoke plume moving to the north.

Flight Status

The order to launch the aircraft was given 0655 local on 6 April 2018 and the aircraft was airborne at 0755. The initial data collection run over the site was at 0822 (local) The aircraft made a total of 15 data collection passes; flight information is summarized in Appendix A and Figure 2.

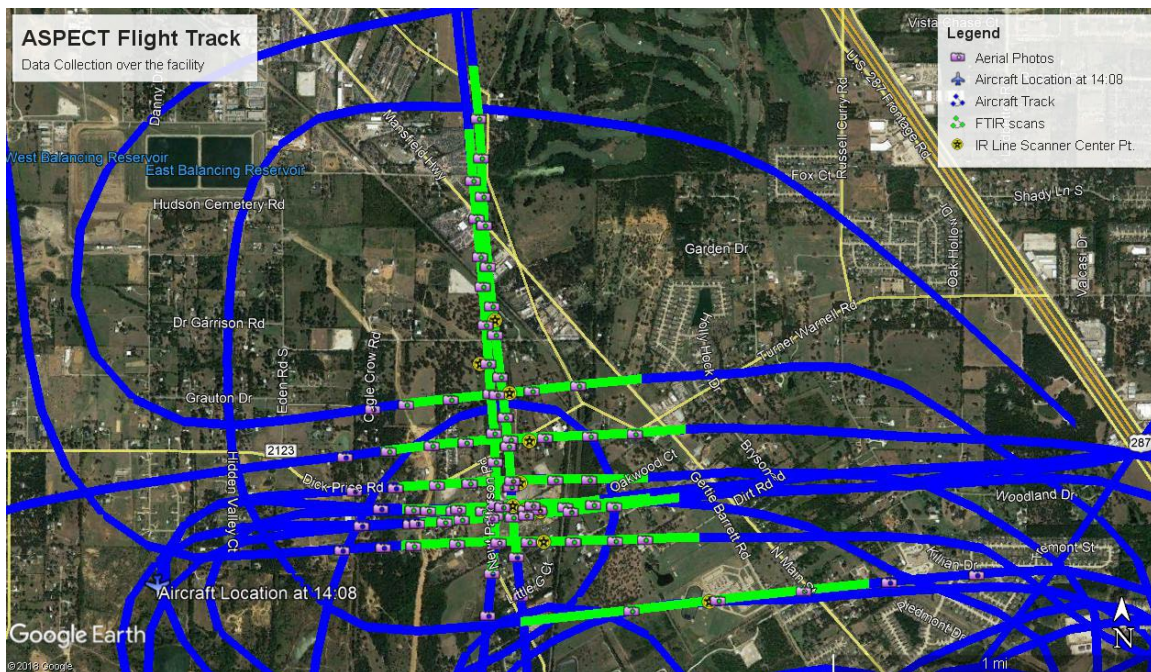


Figure 2: Data collection passes, Clean Solvents Recycling, Mansfield, TX

Data Results

Line Scanner Data Results

A total of 1 test and 12 data passes were made in the proximity of the site and an infrared line scanner images were generated for each pass. It should be noted that the RS800 line scanner is configured for optimal image generation at an altitude of 853 m above ground level (AGL)(2800 ft). Since the cloud ceiling was just above 213 m (700 ft) all IR imagery exhibited under-scanned distortion. This distortion makes objects in the direction of flight appear longer than they. IR and spectral content are not affected by this type of distortion. Figure 3 shows a typical 3-band image obtained from data collected for Run 10. The highlighted area shows the location of the facility. Examination of the detail shows slightly elevated temperatures in relation to the surrounding area (white is hot). By this time in the life of the fire, personnel had foamed the fire and greatly reduced the thermal signature of the fire. An IR plume was not observed on any of the collection flights.



Figure 3: – 3 band IR image, Run 15, Tri-Chem Industries

FTIR Data Results

FTIR Spectral data at a resolution of 16 wavenumbers was collected for each pass. ASPECT uses an automated detection algorithm to permit compounds to be analyzed while the aircraft is in flight. 78 compounds are included in this algorithm and the list and associated detection limits are given in Table 2. In addition, collected data are also manually analyzed by comparing any detected spectral signatures to a collection of published library spectra.

Methyl acetate was the only compound detected on this mission and the detection of 1.2 ppm was just above the detection limit for the system (figure 4 and table 3). Figure 5 shows the spectra of the detection with characteristic peak near 1030 and 1300 wavenumbers. The peak below 800 wavenumbers is CO₂. It should be noted that the apparent baseline shift of the data is due to the passive nature of the data. The concentration reported by the system is likewise confirmed due to the low signal to noise ratio (approximately 3) of the data. The detection was made immediately downwind of the fire as part of data run 10. No other data passes showing detectable results for any other compounds. Based on limited information about the facility, the detection of this compound is consistent with recycled paint and lacquer solvents. The low concentration

of the compound suggests that limited quantities were on site, material was not involved in the fire, or the bulk of material burned up

TABLE 2 - Chemicals Included in the ASPECT Auto-Processing Library

Acetic Acid	Cumene	Isoprene	Propylene
Acetone	Diborane	Isopropanol	Propylene Oxide
Acrolein	1,1-Dichloroethene	Isopropyl Acetate	Silicon Tetrafluoride
Acrylonitrile	Dichloromethane	MAPP	Sulfur Dioxide
Acrylic Acid	Dichlorodifluoromethane	Methyl Acetate	Sulfur Hexafluoride
Allyl Alcohol	Difluoroethane	Methyl Ethyl Ketone	Sulfur Mustard
Ammonia	Difluoromethane	Methanol	Nitrogen Mustard
Arsine	Ethanol	Methylbromide	Phosgene
Bis-Chloroethyl Ether	Ethyl Acetate	Methylene Chloride	Phosphine
Boron Tribromide	Ethyl Formate	Methyl Methacrylate	Tetrachloroethylene
Boron Trifluoride	Ethylene	MTEB	1,1,1-Trichloroethane
1,3-Butadiene	Formic Acid	Naphthalene	Trichloroethylene
1-Butene	Freon 134a	n-Butyl Acetate	Trichloromethane
2-Butene	GA (Tabun)	n-Butyl Alcohol	Triethylamine
Carbon Tetrachloride	GB (Sarin)	Nitric Acid	Triethylphosphate
Carbonyl Chloride	Germane	Nitrogen Trifluoride	Trimethylamine
Carbon Tetrafluoride	Hexafluoroacetone	Phosphorus Oxychloride	Trimethyl Phosphite
Chlorodifluoromethane	Isobutylene	Propyl Acetate	Vinyl Acetate



Figure 4: Chemical Detection Locations, Clean Solvents Recycling

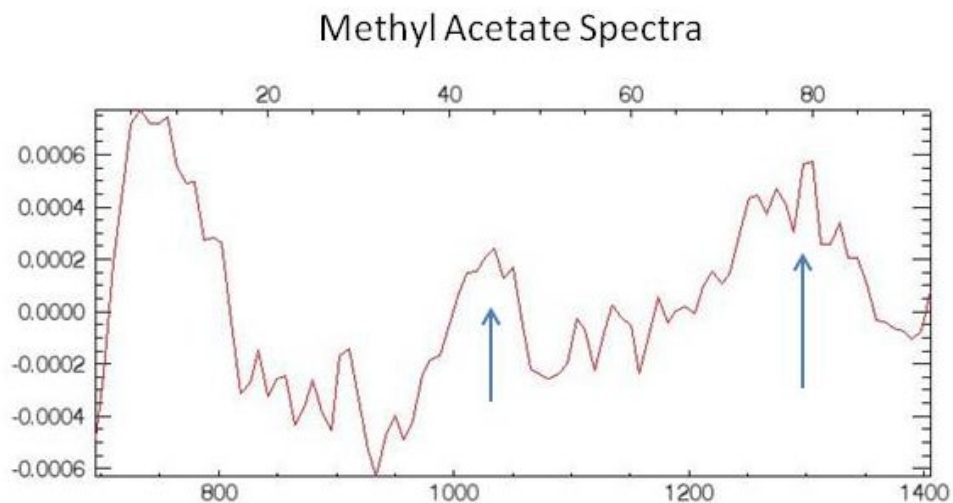


Figure 5: Methyl Acetate Spectra, Clean Solvents Recycling

Table 3. Chemical Results Summary

Run	Date	Time (UTC)	Chemical	Max Concentration ppm
1	6 April 2018	1314	Test	Test
2		1322	None	None
3		1325	None	None
4		1328	None	None
5		1332	None	None
6		1335	None	None
7		1341	None	None
8		1344	None	None
9		1352	None	None
10		1355	Methyl acetate	1.2
11		1407	None	None
12		1414	None	None
13		1418	None	None

Aerial Photography Results

A full set of high resolution aerial digital photography were collected as part of the flight. Figure 6 shows a representative image collected as part of Run 2. This image has been ortho-rectified with the top of the image being north. An immediate feature of the image is the faint plume moving toward the north. The facility which is located in the center-left of the frame clearly shows damage to the roof. Figure 7 shows a typical oblique image collected from the right side of the aircraft. This image is not geo-

rectified. The top of the image is looking to the south. Examination of the image clearly shows the extent of firefighting foam around the facility and the presence of a small amount of white smoke moving generally to the north.

Conclusions

ASPECT was dispatched at the request of the EPA Region VI emergency response program to provide air monitoring of the Clean Solvents Recycling fire. ASPECT arrived on-site at 0822 (local) and began the first of 12 data collection passes. Methyl acetate was detected on pass 10 north east of the fire at a concentration of 1.2 ppm. No other compounds were detected. IR imagery collected over the fire tended to show fairly low temperatures as a result of ongoing fire fighting operations.

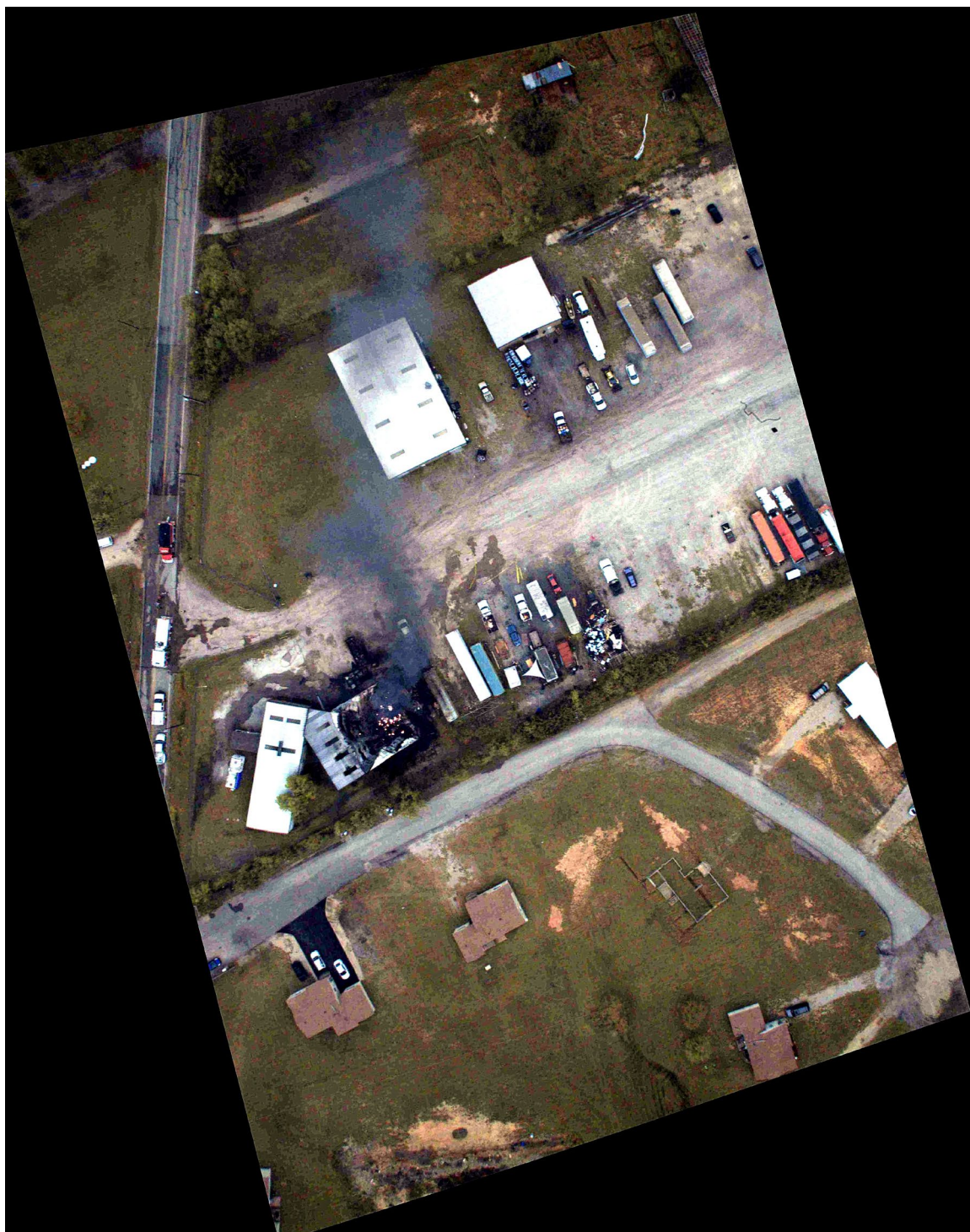


Figure 6: Aerial image Clean Solvents Recycling



Figure 7. Oblique Image, Clean Solvents Recycling

Appendix A

Abbreviations:

DEM – Digital elevation model
Alt – Altitude (in feet)
MSL – Mean sea level altitude (in feet)
Digital – Digital photography file from the Nikon D2X camera
MSIC – Digital photography file from the Imperx mapping camera
FTIR – Spectral IR data collected with a Fourier Transform
Infrared Spectrometer
IRLS – Infrared Line Scanner
Jpg – JPEG image format
UTC – Universal Time Coordinated
img – Spectral data format based on Grams format

Mission: 2018-04-06 Mansfield Fire

Date: 4/6/2018

Time UTC: 13:10

Aircraft Number: N9738B

Pilot: Beorn Ledger

Copilot: Tom Crews

Operator: Gerry Broyles

Aft Operator: Craig McGee

Ground Controller: Mark Thomas

DEM: Using elevation from DEM Database

Run: 1 Time: 13:14:39 UTC

Alt: 1325 ft MSL Elev: 695 ft Elevation from DEM Database

Vel: 131 knots Heading: 91

Digitals: 5

24mm2018_04_06_13_14_46.jpg

24mm2018_04_06_13_14_52.jpg

24mm2018_04_06_13_14_59.jpg

24mm2018_04_06_13_15_05.jpg

24mm2018_04_06_13_15_11.jpg

MSIC: 5

20180406131452200.jpg

20180406131458549.jpg

20180406131504914.jpg

20180406131511263.jpg

20180406131517628.jpg

FTIR: 1

20180406_131444_A.igm

IRLS: 1

2018_04_06_13_14_45_R_01

Gamma Runs: None

Run: 2 Time: 13:22:42 UTC

Alt: 1407 ft MSL Elev: 722 ft Elevation from DEM Database

Vel: 111 knots Heading: 254

Digitals: 4

24mm2018_04_06_13_22_45.jpg

24mm2018_04_06_13_22_48.jpg

24mm2018_04_06_13_22_52.jpg

24mm2018_04_06_13_22_55.jpg

MSIC: 4

20180406132251573.jpg

20180406132254303.jpg

20180406132257938.jpg

20180406132300652.jpg

FTIR: 1

20180406_132246_A.igm

IRLS: 1

2018_04_06_13_22_47_R_02

Gamma Runs: None

Run: 3 Time: 13:25:21 UTC

Alt: 1290 ft MSL Elev: 721 ft Elevation from DEM Database

Vel: 113 knots Heading: 255

Digitals: 7

24mm2018_04_06_13_25_24.jpg

24mm2018_04_06_13_25_27.jpg

24mm2018_04_06_13_25_31.jpg

24mm2018_04_06_13_25_34.jpg

24mm2018_04_06_13_25_37.jpg

24mm2018_04_06_13_25_41.jpg

24mm2018_04_06_13_25_44.jpg
MSIC: 7

20180406132530459.jpg
20180406132533189.jpg
20180406132536809.jpg
20180406132540444.jpg
20180406132543174.jpg
20180406132546808.jpg
20180406132550428.jpg

FTIR: 1

20180406_132525_A.igm

IRLS: 1

2018_04_06_13_25_26_R_03

Gamma Runs: None

Run: 4 Time: 13:28:51 UTC

Alt: 1445 ft MSL Elev: 714 ft Elevation from DEM Database

Vel: 119 knots Heading: 254

Digital: 8

24mm2018_04_06_13_28_54.jpg
24mm2018_04_06_13_28_58.jpg
24mm2018_04_06_13_29_01.jpg
24mm2018_04_06_13_29_04.jpg
24mm2018_04_06_13_29_08.jpg
24mm2018_04_06_13_29_11.jpg
24mm2018_04_06_13_29_14.jpg
24mm2018_04_06_13_29_17.jpg

MSIC: 8

20180406132900186.jpg
20180406132903821.jpg
20180406132907456.jpg
20180406132910170.jpg
20180406132913805.jpg
20180406132916535.jpg
20180406132920154.jpg
20180406132923789.jpg

FTIR: 1

20180406_132855_A.igm

IRLS: 1

2018_04_06_13_28_56_R_04

Gamma Runs: None

Run: 5 Time: 13:32:30 UTC

Alt: 1344 ft MSL Elev: 709 ft Elevation from DEM Database

Vel: 123 knots Heading: 253

Digitals: 4

24mm2018_04_06_13_32_40.jpg

24mm2018_04_06_13_32_43.jpg

24mm2018_04_06_13_32_46.jpg

24mm2018_04_06_13_32_50.jpg

MSIC: 6

20180406133238992.jpg

20180406133242627.jpg

20180406133245341.jpg

20180406133248976.jpg

20180406133252611.jpg

20180406133255341.jpg

FTIR: 1

20180406_133234_A.igm

IRLS: 1

2018_04_06_13_32_35_R_05

Gamma Runs: None

Run: 6 Time: 13:35:03 UTC

Alt: 1438 ft MSL Elev: 702 ft Elevation from DEM Database

Vel: 105 knots Heading: 176

Digitals: 13

24mm2018_04_06_13_35_09.jpg

24mm2018_04_06_13_35_12.jpg

24mm2018_04_06_13_35_16.jpg

24mm2018_04_06_13_35_19.jpg

24mm2018_04_06_13_35_22.jpg

24mm2018_04_06_13_35_26.jpg

24mm2018_04_06_13_35_29.jpg

24mm2018_04_06_13_35_32.jpg

24mm2018_04_06_13_35_36.jpg

24mm2018_04_06_13_35_39.jpg

24mm2018_04_06_13_35_42.jpg

24mm2018_04_06_13_35_45.jpg

24mm2018_04_06_13_35_49.jpg

MSIC: 14

20180406133511514.jpg

20180406133515149.jpg

20180406133518783.jpg
20180406133521513.jpg
20180406133525133.jpg
20180406133528767.jpg
20180406133531497.jpg
20180406133535132.jpg
20180406133538751.jpg
20180406133541481.jpg
20180406133545116.jpg
20180406133547831.jpg
20180406133551465.jpg
20180406133555100.jpg

FTIR: 2

20180406_133506_A.igm
20180406_133545_A.igm

IRLS: 1

2018_04_06_13_35_08_R_06

Gamma Runs: None

Run: 7 Time: 13:41:14 UTC

Alt: 1451 ft MSL Elev: 714 ft Elevation from DEM Database

Vel: 111 knots Heading: 256

Digitals: 8

24mm2018_04_06_13_41_21.jpg
24mm2018_04_06_13_41_24.jpg
24mm2018_04_06_13_41_27.jpg
24mm2018_04_06_13_41_31.jpg
24mm2018_04_06_13_41_34.jpg
24mm2018_04_06_13_41_37.jpg
24mm2018_04_06_13_41_41.jpg
24mm2018_04_06_13_41_44.jpg

MSIC: 9

20180406134123762.jpg
20180406134126492.jpg
20180406134130111.jpg
20180406134133746.jpg
20180406134136476.jpg
20180406134140110.jpg
20180406134143730.jpg
20180406134146460.jpg
20180406134150094.jpg

FTIR: 1

20180406_134119_A.igm

IRLS: 1

2018_04_06_13_41_20_R_07

Gamma Runs: None

Run: 8 Time: 13:44:55 UTC

Alt: 1427 ft MSL Elev: 705 ft Elevation from DEM Database

Vel: 104 knots Heading: 179

Digitals: 10

24mm2018_04_06_13_45_05.jpg

24mm2018_04_06_13_45_12.jpg

24mm2018_04_06_13_45_15.jpg

24mm2018_04_06_13_45_18.jpg

24mm2018_04_06_13_45_22.jpg

24mm2018_04_06_13_45_25.jpg

24mm2018_04_06_13_45_28.jpg

24mm2018_04_06_13_45_32.jpg

24mm2018_04_06_13_45_35.jpg

24mm2018_04_06_13_45_38.jpg

MSIC: 13

20180406134504377.jpg

20180406134508012.jpg

20180406134511647.jpg

20180406134514377.jpg

20180406134518012.jpg

20180406134521631.jpg

20180406134524361.jpg

20180406134527980.jpg

20180406134530710.jpg

20180406134534345.jpg

20180406134537980.jpg

20180406134540694.jpg

20180406134544329.jpg

FTIR: 2

20180406_134459_A.igm

20180406_134538_A.igm

IRLS: 1

2018_04_06_13_45_01_R_08

Gamma Runs: None

Run: 9 Time: 13:52:31 UTC

Alt: 1438 ft MSL Elev: 718 ft Elevation from DEM Database

Vel: 122 knots Heading: 255

Digitals: 4

24mm2018_04_06_13_52_34.jpg

24mm2018_04_06_13_52_44.jpg

24mm2018_04_06_13_52_51.jpg

24mm2018_04_06_13_52_54.jpg

MSIC: 7

20180406135240148.jpg

20180406135243782.jpg

20180406135247417.jpg

20180406135250132.jpg

20180406135253766.jpg

20180406135256496.jpg

20180406135300131.jpg

FTIR: 1

20180406_135234_A.igm

IRLS: 1

2018_04_06_13_52_36_R_09

Gamma Runs: None

Run: 10 Time: 13:55:52 UTC

Alt: 1502 ft MSL Elev: 720 ft Elevation from DEM Database

Vel: 118 knots Heading: 253

Digitals: 2

24mm2018_04_06_13_56_02.jpg

24mm2018_04_06_13_56_05.jpg

MSIC: 4

20180406135601700.jpg

20180406135605335.jpg

20180406135608065.jpg

20180406135611700.jpg

FTIR: 1

20180406_135556_A.igm

IRLS: 1

2018_04_06_13_55_57_R_10

Gamma Runs: None

Run: 11 Time: 14:07:29 UTC

Alt: 1286 ft MSL Elev: 720 ft Elevation from DEM Database

Vel: 107 knots Heading: 258

Digitals: 2

24mm2018_04_06_14_07_39.jpg

24mm2018_04_06_14_07_52.jpg

MSIC: 7

20180406140738973.jpg

20180406140741703.jpg

20180406140745338.jpg

20180406140748957.jpg

20180406140751687.jpg

20180406140755322.jpg

20180406140758052.jpg

FTIR: 1

20180406_140734_A.igm

IRLS: 1

2018_04_06_14_07_35_R_11

Gamma Runs: None

Run: 12 Time: 14:14:20 UTC

Alt: 1360 ft MSL Elev: 718 ft Elevation from DEM Database

Vel: 109 knots Heading: 252

Digitals: 1

24mm2018_04_06_14_19_06.jpg

MSIC: 6

20180406141429352.jpg

20180406141432987.jpg

20180406141435702.jpg

20180406141439336.jpg

20180406141442971.jpg

20180406141445701.jpg

FTIR: 1

20180406_141424_A.igm

IRLS: 1

2018_04_06_14_14_25_R_12

Gamma Runs: None

Run: 13 Time: 14:18:53 UTC

Alt: 1408 ft MSL Elev: 719 ft Elevation from DEM Database

Vel: 113 knots Heading: 251

Digitals: 1

24mm2018_04_06_14_19_09.jpg

MSIC: 5

20180406141902632.jpg

20180406141905362.jpg

20180406141908981.jpg

20180406141911711.jpg

20180406141915346.jpg

FTIR: 1

20180406_141856_A.igm

IRLS: 1

2018_04_06_14_18_58_R_13

Appendix B.

Tabular Chemical Results

methylacetate

20180406_135556_A_igm

Estimated Detection Limit = 1.02 ppm

Scan	Latitude	Longitude	Concentration ppm
570	32.604425	-97.188952	1.217